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(54) Method for topology analysis in the verification of neighbor and target lists in a CDMA network

(57) A method for analyzing the topology of a CDMA network with respect to both neighbor and target lists is disclosed. The method first defines a language that creates an input source file for communicating the layout of the CDMA network. The language expresses the sector-neighbor list relationships of all sectors in the CDMA network. Next, the method parses and builds a directed graph from the input source file to perform topology analysis of the CDMA network. The method then analyzes the input source file and directed graph for possible errors in the network layout that will lead to dropped calls. The method renders a report to the user about those error conditions and emits a file to be used as input into the CDMA database.

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Description

BACKGROUND OF THE INVENTION

1. Technical Field:

[0001] The present invention is directed to an improved method for verification of configuration network parameters in a CDMA network by use of topology analysis. Still more particularly the present invention relates to an improved method for maintaining signal connection when a mobile handset moves across a geographical area by performing topology analysis to sector neighbor and target lists utilized in CDMA networks.

Description of the Related Art:

[0002] Types of well-known prior art telecommunication systems are Code Division Multiple Access (CDMA) wireless networks. A mobile handset for use by a consumer communicates within the CDMA wireless network when it is located in a geographical region known as a coverage area. The mobile handset moves within the entire area and the network tracks this movement by dividing the coverage area into smaller regions referred to as cells. Cells may either be omni-sector (containing only one sector) or tri-sector (containing three sectors.) A handoff occurs when the mobile handset moves between different sectors in the coverage area. Additionally, the CDMA network internally maintains a database including target and neighbor lists for each sector for use in executing a handoff. These lists are the set of possible sectors into which a mobile handset in a given sector may handoff.

[0003] In use, a mobile handset originates in a serving sector. As the mobile handset moves across the geographical region, the serving sector must handoff into a target sector that serves the mobile handset better. There are currently three types of handoffs, namely, softer, soft and hard. The softer handoff is a handoff between two sectors that exist on the same cell wherein both sectors must operate at the same frequency and have common neighbor lists. The soft handoff is a handoff between two sectors that exist on different cells wherein both sectors must operate at the same frequency and the target is in the serving sector neighbor list. The hard handoff is a handoff between two sectors wherein the sectors are not necessarily the same frequency or technology. Hard handoffs are allowed only on certain sector types that triggers a handoff and hands the mobile unit into a sector from the target list (as opposed to the neighbor list).

[0004] Soft and softer handoffs are better than hard handoffs because the mobile handset makes the connection with the target sector before breaking with the serving sector. A hard handoff breaks connection with the serving sector before connecting with the target sector. Therefore, a phone call can survive a failed soft or softer handoff attempt than a hard handoff. However, an active phone call may drop if the target sector's attributes conflict with that of the serving sector. One reason these conflicts arise is when the system administrator does not properly configure the neighbor and target list information for placement in the CDMA database. Incorrect lists lead to failed handoffs causing the line of communication to drop or disconnect.

[0005] In view of the above, it should be apparent that a method which provides an automated process for catching many errors that may occur during configuration of neighbor and target lists would be highly desirable. This invention solves this problem in a novel and unique manner not previously known in the art.

[0006] The invention provides a verification method as claimed in Claim 1 and a verification system as defined in Claim 10.

[0007] The present invention can also provide an improved method for verification of configuration network parameters in a CDMA network by use of topology analysis.

[0008] The present invention can also provide a method for analyzing an entire CDMA topology by building a directed graph for use in reducing errors that result in dropped calls.

[0009] The present invention can also provide an improved method for analyzing neighbor and target lists in a CDMA network for inconsistencies of frequency, band class and pilot value.

[0010] A method for analyzing the topology of a CDMA network with respect to both neighbor and target lists is disclosed. The method first defines a language that creates an input source file for communicating the layout of the CDMA network. The language expresses the sector-neighbor list relationships of all sectors in the CDMA network. Next, the method parses and builds a directed graph from the input source file to perform topology analysis of the CDMA network. The method then analyzes the input source file and directed graph for possible errors in the network layout that will lead to dropped calls. The method renders a report to the user about those error conditions and emits a file to be used as input into the CDMA network database.

[0011] The above as well as additional objects, features, and advantages of the present invention will become anparent in the following detailed written description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself however, as well as a preferred mode of use, further objects and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figure 1 is a high-level block diagram of a method for verification of configuration parameters in a CDMA network in accordance with the present invention;

Figure 2 is one example of an input source file for use with the method shown in **Figure 1**;

Figure 3 is a directed graph built from the input source file shown in **Figure 2**;

Figure 4 is a directed graph comparing targets and neighbor lists for inconsistencies;

Figure 5 is a directed graph for analyzing pilot beacon target lists;

Figure 6 is a high-level flowchart for updating a CDMA database in accordance with the present invention; and

Figure 7 is an example of an output report using the method and source input file shown in Figure 2 in accordance with the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0013] With reference now to the figures and in particular with reference to **Figure 1**, there is depicted a high-level block diagram of a method **10** for verification of configuration parameters in a CDMA network in accordance with the present invention. The method **10** is novel over prior art techniques by the addition of using both an input source file and a topology analyzer in verifying configuration parameters in a CDMA network. Referring once again to **Figure 1**, the method starts by creating an input source file **20** that represents the layout of a CDMA network. The input source file **20** is then interpreted by a topology analyzer **22** wherein information is parsed, and stored internally as a directed graph **24**.

[0014] The following forms of analysis are then done on the directed graph **24** to validate the directness of the input. This begins as shown in step **24**, analysis of both neighbor and target lists for inconsistencies. Next, as shown in steps **26** and **28**, analyzing mutually inclusive neighbor lists and a PILOT BEACON Target List. The final analysis performed by the method 10 of the present invention is analyzing sector entry, cell entry and cell exit dominators, shown in steps **30, 32** and **34** respectively. An error report is the sorted and built and sent to a user as shown in steps **36** and **40**. By way of example, but not of limitation, the report is sorted in the following order, input line number, field in error and the severity of the error.

[0015] Turning now to **Figure 2**, there is shown one example of an input source file for use with the method **10** shown in **Figure 1**. In a preferred embodiment, all input source files **20** have the following four sections, a template, SBS subsystem list, updates list and a spreadsheet table.

[0016] In accordance with the present invention, a language is developed and used in creating the input source file **20**. This language supports the following lexemes:

* Identifiers: An identifier may be any combination of alphanumeric characters up to 32 characters. The following characters are allowed to be in the word (case-insensitive): A-Z.0-9,@,4,5,7,_,<.>.?.

* Keywords: A keyword is identifiers with specific meaning to the parser.

* Numbers: Any positive/negative numeric value may be expressed here. A negative value must be preceded with a "-".

* Boolean: A boolean begins with either a "T" or "F" value. "T" stands for TRUE (e.g. Multipilot is enabled), and "F" stands for false.

* Enumeration: A set of identifiers that are expected within a field.

* Comma Lists: A comma list is a list of one or more identifier. Each identifier in the list is separated by only one comma and any number of whitespace characters. A comma list may contain only one identifier; however, no comma is necessary.

* Empty Comma List: The "*" is used to mark a field as containing an empty list.

* Lexical escape: All records are read as line format. The "¦"at the very end of a line is used for line continuation. Note, this is very important since the termination of a record coincides with the termination with the line of input. Also, this is really a lexical escape that preserves the subsequent character from having any meaning.

[0017] All of these sections may be interspersed with comments. Referring once again to **Figure 2**, there are two types of comments:

* END OF LINE: Ignores everything from "//" **42** to end of line.

* MULTI-LINE-COMMENT: Ignore everything starting with "/*" and ending with "/*". This may (and may not) cross several lines.

[0018] Turning once again to **Figure 2**, the template of the input source file **20** is now described in detail. The template begins with the keyword /NYCFx.x=, shown as **44**. The "x.X" varies between releases, and it informs the current parser about the syntactic version of the file. A comma list of other keywords **46** follows this keyword. These keywords **46** define the expected columnar order of the values for each sector, and each keyword corresponds to one field in the record for a sector. The following is the list of keywords:

* **KEY**: 32 character identifier to uniquely label the sector.

* **CELLNAME**: 32 character identifier for the cell such as MiniBTS8.

* **CELLID**: Numeric value for the logical cell id.

* **BAND**: Enumeration of 1900,800 or AMPS.

* **FREQ**: Numeric value.

* **SECTOR**: Enumeration of Alpha, Beta, Gamma, Omni.

* **MSCID_MKT**: Numeric value describing the MSC Mkt Id.

* **MSCID_SWNO**: Numeric value describing the MSC Switch Number.

* **BSCID**: Numeric value describing the BSC.

* **PILOT**: Number between 0-511.

* **NEIGHBORS**: Comma list of keys describing each of the neighbors.

* **BORDERTARGET**: Comma list of target cells for Border handoffs.

* **BEACONTARGET**: Comma list of pairs target cells and pilot pns for Pilot Beacon handoffs.

* **EHHOTARGETCELL**: Comma list of target cells for EHHO.

* **CELLTYPE**: Enumeration Standard. Pilot_Beacon, EHHO, and Border.

* **PILOTINCR**: Numeric value for the pilot increment in the neighbors list

[0019] The SBS list must by on the second line of input and defines all the SBS that exists for the system. As shown in **Figure 2**, the following is the syntax **48**: /SBS=list, wherein the list is a comma list of identifiers where each identifier

is the name of the SBS table to update. The sector database may be quite sizeable. Therefore, an optional directive listing all of the sectors to update is present. This must follow both the template and the SBS list definitions. The syntax begins with the "/UPDATE=" keyword followed by a comma list of SECTORS (for example, /UPDATES=Dallas_8A, Dallas_8B.Dallas_8G.) All sectors will be updated/checked when this keyword is not present.

[0020] Referring once again to **Figure 2**, the spreadsheet table consists of rows **50** and columns **52** wherein each column **52** is described by the template. A column **52** is a field within the sector record such as PILOT value, FREQUENCY, NEIGHBOR LIST, ETC. Each row **50** corresponds to a sector in the CDMA network. Each line of input is a row **50** and may have a lexical escape "\end-of-line" if the sector requires more than one line. The "key" **54** is an identifier used when referencing that sector in the database from another sector. This is necessary for both neighbor and target list support. Both of these lists are comma_list with identifiers that are keys **54** for other sectors.

[0021] Referring now to **Figure 3**, there is shown a directed graph **24** built from the input source file **20** of **Figure 2**. As described above, a topology analyzer (not shown) parses the input source file **20** and builds the directed graph **24**. For description purposes, a directed graph is a common computer science technique for describing topology relationships. As shown in **Figure 3**, the graph is composed of nodes and arcs. A node is an entity in the model, and each arc describes a relationship between two nodes in the model. In this implementation, every node corresponds to one sector, and every sector is drawn in the graph **24**.

[0022] Each node is implemented as a record containing fields, and each field corresponds to one column **52** in the table. Each arc describes a handoff relationship between two nodes with the following three types of arcs, neighbors who may soft/softer handoff into it **56**, neighbors into which it may soft/softer handoff **58** and targets into whom it may hard handoff **60**. Both targets and neighbor into which the node may handoff are determined directly by reading the input source file **20**. Determining neighbors who may soft handoff into the sector are determined by iterating through the table, and drawing arcs back to whichever nodes are in the sector's neighbor list, as shown in **Figure 3**.

[0023] Referring now to **Figure 4**, there is shown a directed graph **62** for analyzing **24** the neighbor list and target list for inconsistencies. For each sector in the table of the input source file **20**, every arc in the neighbor list is walked, and the following comparisons are performed (but not limited to):

* Frequencies must be identical.
* Band (800 Mhz vs 1900MHz) must be identical.
* PILOT_PN values must be different, and a multiple of PILOTINCR.
* No PILOT value should be repeated within this list.
* Check for presence of the other two sectors in the same cell if this is a tri-sector cell.

[0024] For each sector in the table of the input source file **20**, every arc in the target list is walked, and the following comparisons are performed:

```
* Frequencies should be different.

* Presence of target list when the sector type is either
CELL_EHHO,CELL_BORDER, OR CELL_ PiLOT_BEACON.

///
///
///
```

[0025] Below is one example of pseudo-code that may describe aforementioned search:

```
FOREACH sector in table
      FOREACH arc in list of neighbor list
            COMPARE sector to arc.destinationNode.sector
      ENDFORE
      FOREACH arc in list of targets
            COMPARE sector to arc,destinationNODE.sector
      ENDFORE
ENDFOR
```

[0026] All error messages about inconsistencies are stored in the report object that reports the errors later as will be more fully described below. Referring once again to **Figure 4**, "Dallas10Gamma" **64** has two neighbors, "Dallas8Alpha" **66** and "Dallas8Beta" **68** as shown by the "soft handoff into" arc **56** and "soft handoff from" arc **58**. As shown in the summary tables, **70**, **72** and **74** of **Figure 4**, the frequencies and bands are identical, and the PILOT_PN values are different and a multiple of the PILOTINCR. However, an error is detected because Dallas10Gamma **64** does not have in its table **70**, "Alpha" and "Beta" sectors for its cellId 10. Also, "Dallas10Gamma" **64** has one entry in its target list, "FTWorth9Alpha **76** as shown by "hard handoff into" arc **78**. An error is detected because as shown in tables **70** and **80**, for "FTWorth9Alpha" **76** and "Dallas10Gamma" **64** have the same frequencies. Therefore a user should be advised to place "FTWorth9Alpha" **76** in the neighbor list, if possible.

[0027] Turning back to **Figure 3** and referring to the input source file **20** of **Figure 2**, an example of analyzing neighbors to be mutually inclusive is shown. That is, checking that Sector #1 should be in sector #2's neighbor list if Sector #1 contains Sector #2 in its neighbor list. For each sector in the table of the input source file **20**, every arc in the neighbor list is walked. Then, within this inner comparison, every arc in the list of sector that may handoff into this sector is walked. The iteration stops once the match is found. If no match is found within the list, an error message is stored in the report object. The following is an example of pseudo-code for performing this operation:

```
        FOREACH sector in table
              FOREACH ARC in neighbor list
                    FOREACH arc in list of neighbor who may handoff
  into it                                   COMPARE    sector    to
  arc.destination Node.sector                                 ENDFOR
                    IF no match
                    THEN
                          Report Error
                    ENDIF
              ENDFOR
        ENDFOR
```

[0028] As shown in **Figure 3**, the neighbor list for "Dallas10Gamma" **64** should contain "Dallas8Gamma" **82**, "Dallas9Alpha" **84**, "Dallas9Beta" **86**, "Dallas9Gamma" **88**, "Dallas 10Alpha" **90**, and "Dallas10Beta" **92**. All of those do contain "Dallas10Gamma" **64** in their respective neighbor lists.

[0029] Referring now to **Figure 5**, there is shown a directed graph **94** for analyzing a Pilot Beacon Target List **96**. The Pilot Beacon Target List **96** is unique because it has the following fields:

* Pilot_PN: The PILOT value for the neighbor handing into it

* TargetList: A list of targets for that PILOT only.

[0030] A call will drop or disconnect if the PILOT_PN of the neighbor handing into the PILOT BEACON sector is not found in the target list. For each PILOT BEACON sector in the table, every arc in the list of neighbors that may handoff into is walked. Then, within this inner comparison, every entry in the PILOT BEACON target list is walked. The search stops on the first match of the two PILOT PN values. An error message is reported if no match is found. The following is an example of pseudo-code for performing this operation:

```
FOREACH sector in table
      If sector_type=PILOT_BEACON
      FOREACH  arc in list of neighbor who may handoff into it

            FOR each entry in the PILOT BEACON Target List of
the sector
                        COMPARE TargetLIst.Entry.PILOT_PN
                        t                                   o
arc.destinationNode.sector.PILOT_PN
            ENDFOR
            IF no match
            THEN
                        Report Error
            ENDIF
      ENDFOR
      ENDIF
ENDFOR
```

[0031] As shown by **Figure 5**, an error is detected. The target list of "Dallas10Beta" **64** does not contain the PILOT_PN values of sectors that may hand into it. More specifically, Dallas8Alpha (80) **66**, Dalla8Gamma(88) **82**, Dallas9Beta (96) **86**, and Dallas9Gamma(100) **88** can soft handoff into it. The PILOT values in (80, 88, 96, and 100) need to be in the PILOT BEACON Target List **96** as shown in the input source file **20**.

[0032] Turning once again to **Figure 3** and the input source file **20** of **Figure 2**, there is shown an example whether a sector dominates a sector upon entry. Sector entry dominators are not necessarily incorrect; however they can lead to wasted capacity because no one may be handing into the sector. For each sector in the table, every arc in the list of neighbors that may handoff into it is counted. An error message is reported if the size is less than or equal to one. The following is an example of pseudo-code for performing this operation:

```
FOREACH sector in table

            COUNT: = 0
            FOREACH arc in list of neighbor who nay into it
                        COUNT: = COUNT+1
      ENDFOR
      IF COUNT<=1
      THEN
            Report Error
      ENDIF
ENDFOR
```

[0033] **Figure 3** has no sector entry dominators because 8 sectors may hand into "Dallas10Gamma" **64**.

[0034] **Figure 3** also describes how to see whether a cell dominates a sector. Cell entry dominators are not incorrect; however they can lead to wasted capacity. For each sector in the table, every arc in the neighbors that may handoff into it is walked. An error message is reported if all of the arcs have the same CELL ID. The following is an example of pseudo-code for performing this operation:

```
FOREACH sector in table
     CELL:=sector.list_neighbor  who  may  hand  into  .  first
arc.dest_node.cell
     CELL_ENTRY_DOMINATOR:=TRUE
     FOREACH arc in list of neighbor who may into it
               IF sector.cell^=arc.node.cell
               THEN
                    CELL_ENTRY_DOMINATOR: = FALSE
               ENDIF
     ENDFOR
     If CELL_ENTRY_DOMINATOR
     THEN
          Report Error
     ENDIF
ENDFORE
```

[0035] **Figure 3** has no cell entry dominators because 3 cells may hand into "Dallas10Gamma" **64**.

[0036] **Figure 3** also contains an example of verifying sector entry dominators. Sector entry dominator can lead to dropped calls when there is an outage in the dominating cell. For each sector in the table, every arc in the neighbor list is walked. An error message is reported if the all of the arcs have the same CELL ID. The following is an example of pseudo-code for performing this operation:

```
FOREACH sector in table
     COUNT: = 0
     FOREACH arc in neighbor list
          COUNT: = COUNT+1
     ENDFOR
     IF COUNT<=1
     THEN
          Report Error
     ENDIF
ENDFOR
```

[0037] **Figure 3** has no errors because "Dallas10Gamma" **64** has two sectors into which it may handoff.

[0038] Lastly **Figure 3** contains an example to verify whether a cell dominates a sector on exit. Cell entry dominators are not incorrect; however they can lead to dropped calls when there is an outage in the dominating cell. For each sector in the table, every arc in the neighbor list is walked. An error message is reported if the all arcs have the same CELL ID. The following is an example of pseudo-code for performing this operation:

```
FOREACH sector in table
     CELL: = sector.neighbor_list.first arc.dest_node.cell
     CELL _EXIT_DOMINATOR: = TRUE
     FOREACH arc in neighbor list
          IF sector.cell^=arc,node.cell
          THEN
               CELL_EXIT_DOMINATOR: = FALSE
          ENDIF
     ENDFOR
```

[0039] In **Figure 3**, an error is detected here because Cell 8 dominates the "Dallas10Gamma" **64**.

[0040] Referring now to **Figure 6**, an intermediate file **100** is emitted by the topology analyzer. This file is organized into two sections; Base Transceiver Subsystem Info and SBS relevant info. The information is then compared, as shown in block **102** against the respective tables in the database **104** system. The database application then updates the database **106**. Referring to **Figure 7**, after all of the analyses is done, a report **98** can be rendered to the user. Error messages are stored in the report object during all phases of analysis. Then, the messages are sorted by the corresponding line number in the input source file **20**. Thus the user can more easily scan the input source file **20** while comparing the results.

[0041] While the invention has been particularly shown and described with reference to a preferred embodiment, it

will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.

Claims

1. A method for verification of both neighbor and target lists in a CDMA network comprising:

creating an input source file for communicating the layout of a CDMA network;

performing topology analysis to parse and build a directed graph from said input source file of said CDMA network;

analyzing both neighbor and target lists using said directed graph for inconsistencies resulting in errors that will lead to dropped calls; and

sorting and building an error report.

2. The method of Claim 1, further comprising:
analyzing mutually inclusive neighbors using said directed graph for said errors that will lead to dropped calls wherein said errors are included in said error report.

3. The method of Claim 1 or 2, further comprising:
analyzing PILOT BEACON target lists using said directed graph for said errors that will lead to dropped calls wherein said errors are included in said error report.

4. The method of Claim 1, 2 or 3 further comnrising:
analyzing sector entry dominators using said directed graph for said errors that will lead to dropped calls wherein said errors are included in said error report.

5. The method of Claim 1, 2, 3 or 4 further comprising:
analyzing cell entry dominators using said directed graph for said errors that will lead to dropped calls wherein said errors are included in said error report.

6. The method of Claim 1, 2, 3, 4 or 5 further comprising:
analyzing cell exit dominators using said directed graph for said errors that will lead to dropped calls wherein said errors are included in said error report.

7. The method of any preceding Claim, further comprising:
creating said input source file having a template, SBS subsystem list, updates list and a spreadsheet table.

8. The method of any preceding Claim, further comprising:
analyzing said inconsistencies for frequency, band class and pilot value errors that will lead to dropped calls wherein said errors are included in said error report.

9. The method of any preceding Claim, further comprising:
defining a language for creating said input source file.

10. A system for verification of both neighbor and target lists in a CDMA network comprising:

means for creating an input source file for communicating the layout of a CDMA network;

means for parsing and building a directed graph having nodes and arcs from said input source file of said CDMA network;

means for analyzing both neighbor and target lists using said directed graph for inconsistencies resulting in errors that will lead to dropped calls; and

means for sorting an building an error report.

11. The system of Claim 10, further comprising:
means for analyzing mutually inclusive neighbors using said directed graph for said errors that will lead to dropped calls wherein said errors are included in said error report.

12. The system of Claim 10 or 11, further comprising:
means for analyzing PILOT BEACON target lists using said directed graph for said errors that will lead to dropped calls wherein said errors are included in said error report.

13. The system of Claim 10, 11 or 12 further comprising:
means for analyzing sector entry dominators using said directed graph for said errors that will lead to dropped calls wherein said errors are included in said error report.

14. The system of Claim 10, 11, 12 or 13, further comprising:
means for analyzing cell entry dominators using said directed graph for said errors that will lead to dropped calls wherein said errors are included in said error report.

15. The system of Claim 10, 11, 12, 13 or 14, further comprising:
means for analyzing cell exit dominators using said directed graph for said errors that will lead to dropped calls wherein said errors are included in said error report.

16. The system of Claim 10, 11, 12, 13, 14 or 15, further comprising:
means for creating said input source file having a template, SBS subsystem list, updates list and a spreadsheet table.

17. The system of any of Claims 10 to 16, further comprising:
means for analyzing said inconsistencies for frequency, band class and pilot value errors that will lead to dropped calls wherein said errors are included in said error report.

18. The system of any of Claims 10 to 17, further comprising:
language means for creating said input source file.

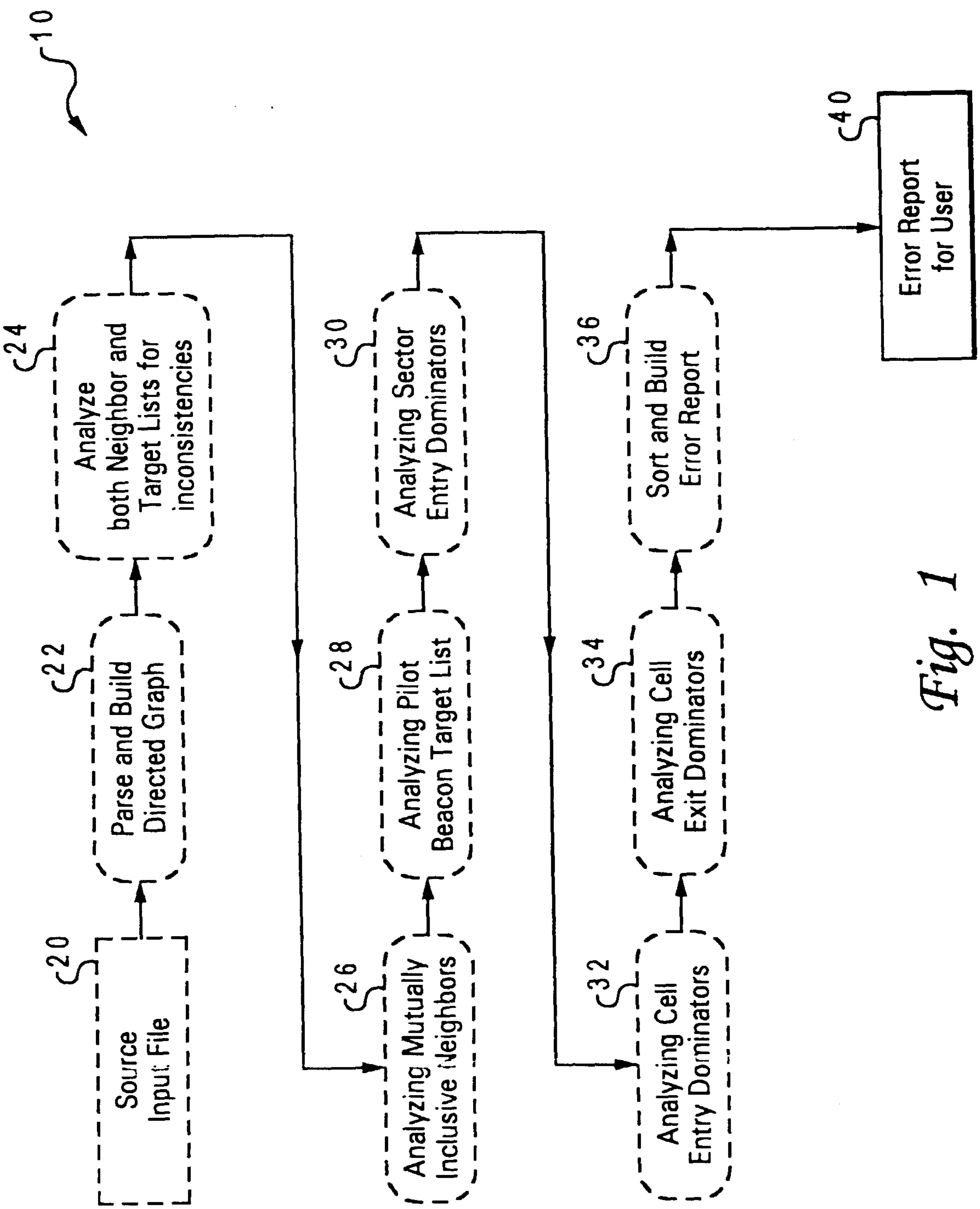

10
20
Source Input File
22
Parse and Build Directed Graph
24
Analyze both Neighbor and Target Lists for inconsistencies
26
Analyzing Mutually Inclusive Neighbors
28
Analyzing Pilot Beacon Target List
30
Analyzing Sector Entry Dominators
32
Analyzing Cell Entry Dominators
34
Analyzing Cell Exit Dominators
36
Sort and Build Error Report
40
Error Report for User

Fig. 1

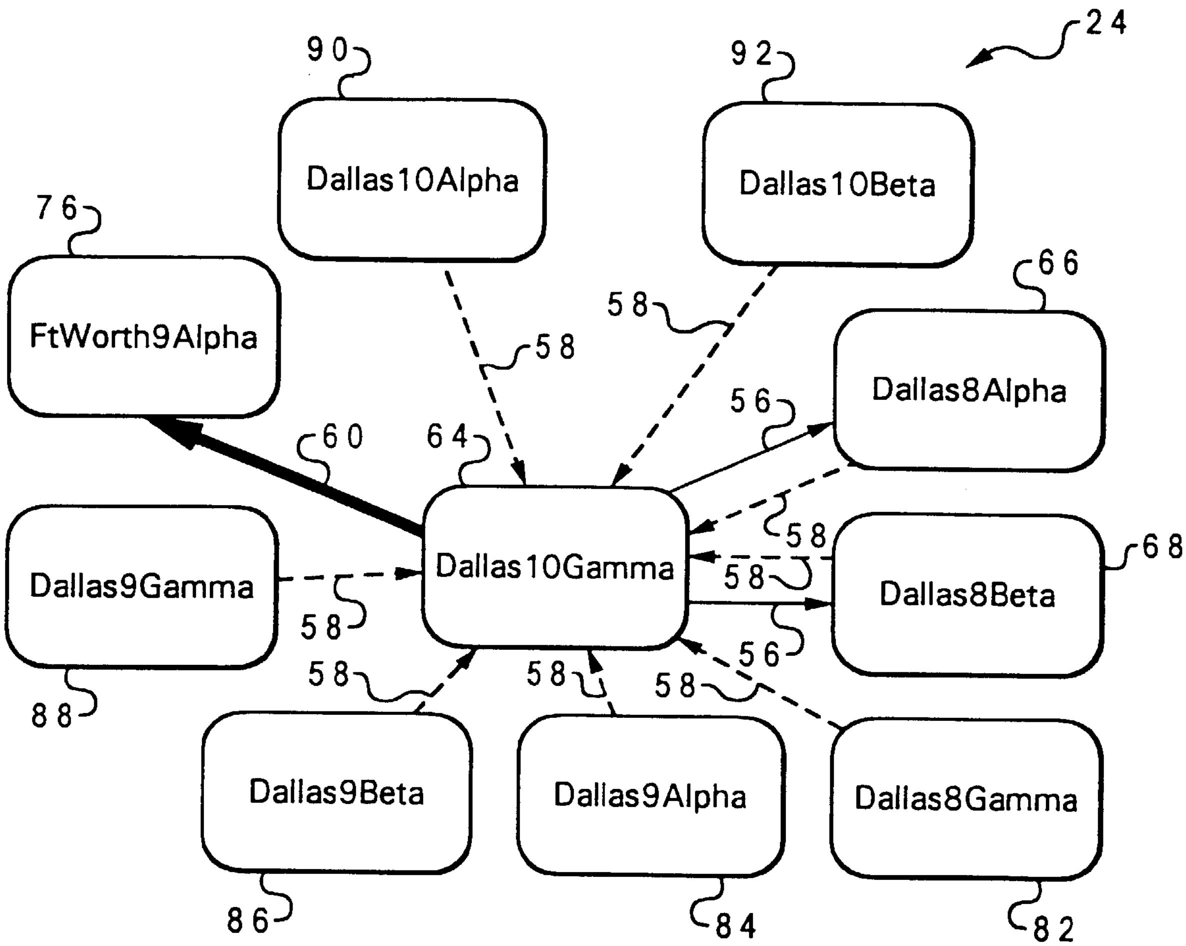
Fig. 2   46   20

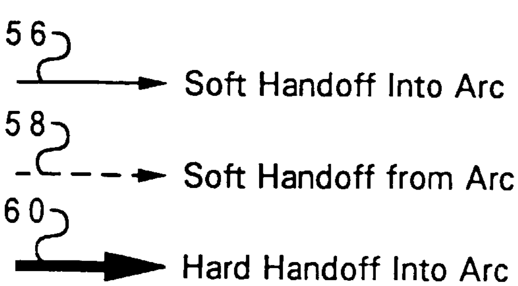
```
44 /NCF7.0=KEY, MSCID_MKT, MSCID_SWNO, BSCID, CELLTYPE, CELLNAME, BAND, \
     CELLID, FREQUENCY, SECTOR, PILOT_PN, NEIGHBORLIST, EHHOTARGET, \
     BORDERTARGET, BEACONTARGET
48 /SBS=foo
   /**************************************************************************/
   // This is an example of the DFW configuration. Dallas contains 3 BTSs (8, 9, 10)
   /**************************************************************************/
   // BTS 8 at Mockingbird and Central
54 //          52                        52
   // Key        MSCID  BSC CellType     CellName    Band   Frq Sect. Pilot
50 // ----       Mkt  Sw ---  --------   --------   ----   ---  ----- -----
   Dallas8Alpha  1  1  1 Cell_Standard Mockingbrd 1900 8 325 Alpha 80 \
                            Dallas8Beta, Dallas8Gamma, \
                 Dallas9Alpha, Dallas9Beta, Dallas9Gamma, \
                 Dallas10Alpha, Dallas10Beta, Dallas10Gamma * * *
   Dallas8Beta   1  1  1 Cell_Standard Mockingbrd 1900 8 325 Beta 84 \
                 Dallas8Alpha,        Dallas8Gamma, \
                 Dallas9Alpha, Dallas9Beta, Dallas9Gamma, \
50               Dallas10Alpha, Dallas10Beta, Dallas10Gamma * * *
   Dallas8Gamma  1  1  1 Cell_Standard Mockingbrd 1900 8 425 Gamma 88 \
                                 Dallas8Gamma, \
                 Dallas9Alpha, Dallas9Beta, Dallas9Gamma, \
                 Dallas10Alpha, Dallas10Beta, Dallas10Gamma * * *

42 // BTS 9 at I35 and Harry Hines
   //
   Dallas9Alpha  1  1  1 Cell_Standard HarryHines 1900 9 325 Alpha 92 \
                 Dallas8Alpha, Dallas8Beta, Dallas8Gamma, \
                            Dallas9Beta, Dallas9Gamma, \
50               Dallas10Alpha, Dallas10Beta, Dallas10Gamma * * *
   Dallas9Beta   1  1  1 Cell_Standard HarryHines 1900 9 325 Beta 96 \
                 Dallas8Alpha, Dallas8Beta, Dallas8Gamma, \
                 Dallas9Alpha,        Dallas9Gamma, \
50               Dallas10Alpha, Dallas10Beta, Dallas10Gamma * * *
   Dallas9Gamma  1  1  1 Cell_Standard HarryHines 1900 9 325 Gamma 100 \
                 Dallas8Alpha, Dallas8Beta, Dallas8Gamma, \
                 Dallas9Alpha, Dallas9Beta, \
                 Dallas10Alpha, Dallas10Beta, Dallas10Gamma * * *

   // BTS 10 at Valley View and LBJ
50 //
   Dallas10Alpha  1  1  1 Cell_Standard ValleyView 1900 10 325 Alpha 92 \
                 Dallas8Alpha, Dallas8Beta, Dallas8Gamma, \
                 Dallas9Alpha, Dallas9Beta, Dallas9Gamma, \
                            Dallas10Beta, Dallas10Gamma * * *
   Dallas10Beta  1  1  1 Cell_Pilot_Beacon ValleyView 1900 10 325 Beta 96 * * * \
                 92, Denton11Alpha, 84, FtWorth9Alpha
   Dallas10Gamma  1  1  1 Cell_Border ValleyView 1900 10 325 Gamma 100 \
                 Dallas8Alpha, Dallas8Beta * FtWorth9Alpha *

50
   FtWorth9Alpha   1  1  1 Cell_Standard Cowtown 1900 9 325 Alpha 92 * * * *
   Denton11Alpha   1  1  1 Cell_Standard UNT 1900 11 125 Alpha 212
```





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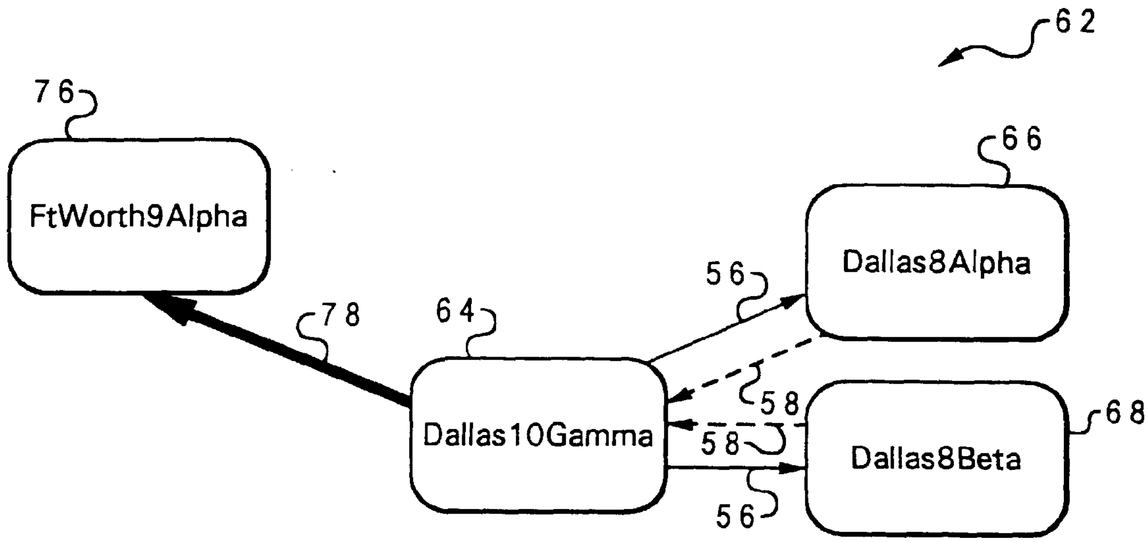
Fields within Dallas10Gamma

Key: Dallas10Gamma
MSCID Mkt Id: 1
MSCID Switch Number: 1
CellType: Cell_Border
CellName: ValleyView
Band: 1900
CellId: 10
Frequency: 325
Sector: Gamma
Pilot_PN: 100

Fig. 3



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Fields within Dallas10Gamma

Key: Dallas10Gamma
MSCID Mkt Id: 1
MSCID Switch Number: 1
CellType: Cell_Border
CellName: ValleyView
Band: 1900
CellId: 10
Frequency: 325
Sector: Gamma
Pilot_PN: 100

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Fields within FortWorth9Alpha

Key: FortWorth9Alpha
MSCID Mkt Id: 1
MSCID Switch Number: 1
CellType: Cell_Standard
CellName: Mockingbid
Band: 1900
CellId: 9
Frequency: 325
Sector: Alpha
Pilot_PN: 80

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Fields within Dallas8Alpha

Key: Dallas8Alpha
MSCID Mkt Id: 1
MSCID Switch Number: 1
CellType: Cell_Standard
CellName: Mockingbid
Band: 1900
CellId: 8
Frequency: 325
Sector: Alpha
Pilot_PN: 80

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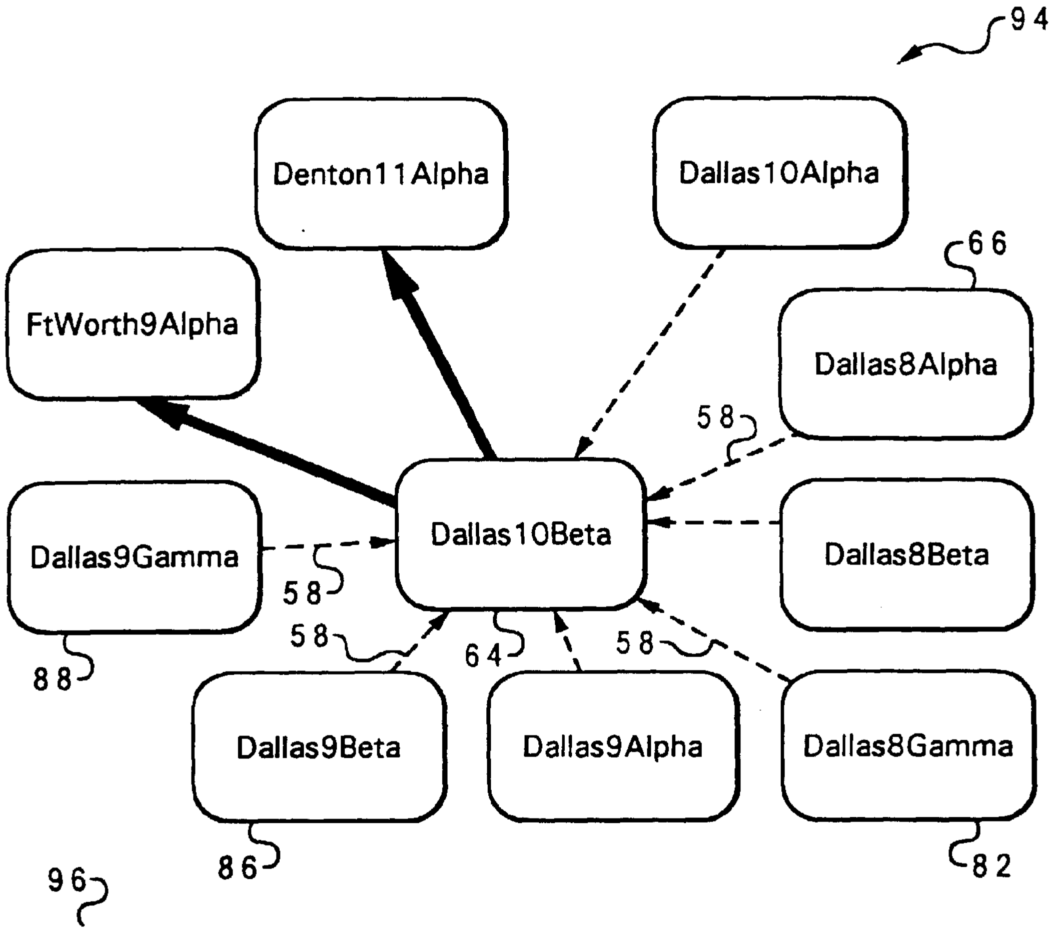
Fields within Dallas8Beta

Key: Dallas8Alpha
MSCID Mkt Id: 1
MSCID Switch Number: 1
CellType: Cell_Standard
CellName: Mockingbid
Band: 1900
CellId: 8
Frequency: 325
Sector: Beta
Pilot_PN: 84

Fig. 4



Pilot Beacon Target List

Pilot_PN	**Target**
84	**FtWorth9Beta**
92	**Denton11Alpha**

Fig. 5

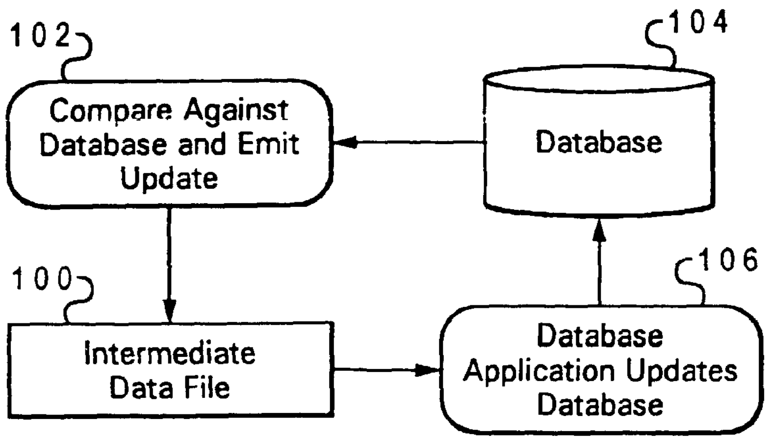


Fig. 6

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DALLAS8ALPHA (line 28) ------------------------
WARN NEIGHBORLIST DALLAS8GAMMA does not have the same frequency
WARN NEIGHBORLIST DALLAS9ALPHA and DALLAS10ALPHA have the same pilot pn
WARN NEIGHBORLIST DALLAS9BETA and DALLAS10BETA have the same pilot pn
WARN NEIGHBORLIST DALLAS9GAMMA and DALLAS10GAMMA have the same pilot pn

DALLAS8BETA (line 34) ------------------------
WARN NEIGHBORLIST DALLAS8GAMMA does not have the same frequency
WARN NEIGHBORLIST DALLAS9GAMMA and DALLAS10GAMMA have the same pilot pn
WARN NEIGHBORLIST DALLAS9BETA and DALLAS10BETA have the same pilot pn
WARN NEIGHBORLIST DALLAS9ALPHA and DALLAS10ALPHA have the same pilot pn

DALLAS8GAMMA (line 40) ------------------------
WARN NEIGHBORLIST DALLAS10GAMMA does not have the same frequency
WARN NEIGHBORLIST DALLAS10BETA does not have the same frequency
WARN NEIGHBORLIST DALLAS10ALPHA does not have the same frequency
WARN NEIGHBORLIST DALLAS9GAMMA and DALLAS10GAMMA have the same pilot pn
WARN NEIGHBORLIST DALLAS9GAMMA does not have the same frequency
WARN NEIGHBORLIST DALLAS9BETA does not have the same frequency
WARN NEIGHBORLIST DALLAS9ALPHA and DALLAS10ALPHA have the same pilot pn
WARN NEIGHBORLIST DALLAS9BETA and DALLAS10BETA have the same pilot pn
WARN NEIGHBORLIST DALLAS9ALPHA does not have the same frequency
WARN NEIGHBORLIST DALLAS8GAMMA in its own neighbor list
INFO NEIGHBORLIST DALLAS8ALPHA (line 28) is not in list, but DALLAS8ALPHA does contain DALLAS8GAMMA in its list
INFO NEIGHBORLIST Beta sector for this cell not in list
INFO NEIGHBORLIST Alpha sector for this cell not in list
INFO NEIGHBORLIST DALLAS8BETA (line 34) is not in list, but DALLAS8BETA does contain DALLAS8GAMMA in its list

DALLAS9ALPHA (line 48) ------------------------
WARN NEIGHBORLIST DALLAS10ALPHA has the same pilot pn
WARN NEIGHBORLIST DALLAS9GAMMA and DALLAS10GAMMA have the same pilot pn
WARN NEIGHBORLIST DALLAS9BETA and DALLAS10BETA have the same pilot pn
WARN NEIGHBORLIST DALLAS8GAMMA does not have the same frequency

DALLAS9BETA (line 54) ------------------------
WARN NEIGHBORLIST DALLAS9ALPHA and DALLAS10ALPHA have the same pilot pn
WARN NEIGHBORLIST DALLAS10BETA has the same pilot pn
WARN NEIGHBORLIST DALLAS8GAMMA does not have the same frequency
WARN NEIGHBORLIST DALLAS9GAMMA and DALLAS10GAMMA have the same pilot pn

DALLAS9GAMMA (line 60) ------------------------
WARN NEIGHBORLIST DALLAS10GAMMA has the same pilot pn
WARN NEIGHBORLIST DALLAS8GAMMA does not have the same frequency
WARN NEIGHBORLIST DALLAS9ALPHA and DALLAS10ALPHA have the same pilot pn
WARN NEIGHBORLIST DALLAS9BETA and DALLAS10BETA have the same pilot pn

Fig. 7

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(11) EP 1 011 283 A3

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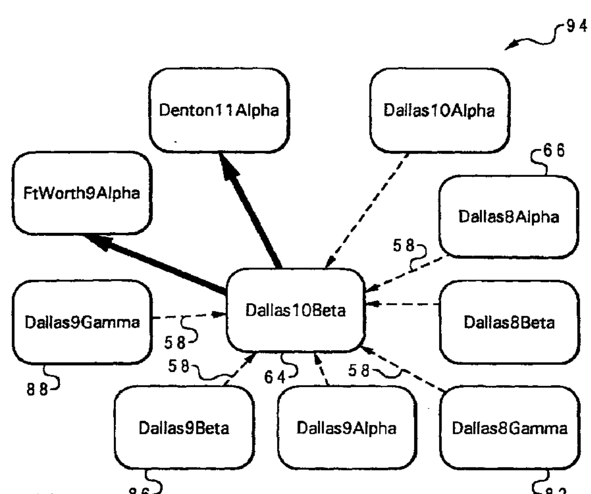
(54) **Method for topology analysis in the verification of neighbor and target lists in a CDMA network**

(57) A method for analyzing the topology of a CDMA network with respect to both neighbor and target lists is disclosed. The method first defines a language that creates an input source file for communicating the layout of the CDMA network. The language expresses the sector-neighbor list relationships of all sectors in the CDMA network. Next, the method parses and builds a directed graph from the input source file to perform topology analysis of the CDMA network. The method then analyzes the input source file and directed graph for possible errors in the network layout that will lead to dropped calls. The method renders a report to the user about those error conditions and emits a file to be used as input into the CDMA database.



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Pilot Beacon Target List

Pilot_PN	Target
84	FtWorth9Beta
92	Denton11Alpha

Fig. 5

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 31 0107

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 0 825 793 A (KONINKLIJKE PTT NEDERLAND N.V.) 25 February 1998 (1998-02-25) * page 4, line 25 - page 6, line 52 * -----	1,10	H04Q7/34
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H04Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 June 2000	Behringer, L.V.

CATEGORY OF CITED DOCUMENTS

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EP 99 31 0107

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19-06-2000

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		NO 973687 A	16-02-1998

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